

REMARKS

Claims 1, 6, 7, 9, 11, 13 and 14 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Petitbon et al. in view of Tane. The Examiner takes the position that Petitbon et al. discloses all of the elements of the claims with the exception of utilizing solid-liquid diffusion in place of conventional solder to join components together. Tane is cited as disclosing the use of solid-liquid diffusion to join components together. The Examiner then states it would be obvious to replace the conventional solder of Petitbon et al. with the solid-liquid diffusion process of Tane. Applicants respectfully traverse the rejection.

The present invention utilizes solid-liquid diffusion in order to join various components of a semiconductor device or a semiconductor module together. The claims refer to a first joining step, a second joining step, a third joining step, etc., each of which utilizes solid-liquid diffusion to join components. In the claimed invention, the series of steps are performed sequentially. As opposed to conventional soldering techniques, solid-liquid diffusion requires the use of both pressure and heat. Accordingly, the present invention allows for various components to be sequentially joined, thereby making it possible to execute pressurization and heating that is appropriate for each required connection. Thus, stable control of the joining processes is reliably achieved.

Petitbon et al. discloses a process in which solder balls 16 are provided on tabs 14 provided on the surface of a die 4. The die 4 is then placed on top of a solder film layer 24 made as the same material as the solder balls 16. A conductive member 26 is then placed on top of the solder balls 16. In addition, the conductive member 26 also is placed on top of the solder film layer 24' that lies on top of the conductive track 22. Once all these elements are in place, soldering occurs either in a two step melt process described in paragraph [0024] or a single melt step as described in paragraph [0025]. In Petitbon et al., all of the soldering is performed simultaneously instead of in a sequential process as claimed.

Tane is cited merely for disclosing the use of solid-liquid diffusion. However, even if it were possible to utilize solid-liquid diffusion in the process of Petitbon et al., the result would not render the present application prima facie as required by 35 U.S.C. 103, as Petitbon et al. specifically teaches a process (namely simultaneous soldering) that is completely different from the sequential process of the claimed invention. At best, the combination proposed by the Examiner would merely result in the use of solid-liquid diffusion in the simultaneous joining process of Petitbon et al., which does not correspond to the claimed invention.

Further, applicants submit that it is unlikely that one could even use solid-liquid diffusion in the simultaneous process of Petitbon et al., as the use of solid-liquid diffusion requires both the application of pressure and heat to the components to be joined. Applicants submit that the Examiner has failed to provide sufficient rationale as to how the multiple connection points of Petitbon et al. can be simultaneously joined using solid-liquid diffusion, namely, how would one apply the necessary pressure to the various connection points simultaneously? Again, if it this were possible, the result would not suggest the advantages and use of sequential joining as only disclosed by the present applicants. The rejection is therefore improper and should be withdrawn.

Claims 8, 10 and 12 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Petitbon et al. in view of Tane and Abys. Abys is cited as disclosing a thin bonding layer. Abys, however, fails to overcome the deficiencies of Petitbon et al. and Tane discussed above. Accordingly, the rejection of claims 8, 10 and 12 is also improper and should be withdrawn.

Applicants submit that, given the allowability of generic claim 1, all of the withdrawn claims should be rejoined and allowed.

Applicants have added new claims 17-22 to further claim the features of the disclosed invention. Applicants submit claims 17-22 are also allowable over the art of record.

In view of the above, all of the claims in this case are believed to be in condition for allowance, notice of which is respectfully urged.

Respectfully submitted,

ROSSI, KIMMS & McDOWELL LLP

Marc A. Rossi
MARC A. ROSSI, REG. NO. 31, 923

20609 GORDON PARK SQUARE, SUITE 150
ASHBURN, VA 20147
703-726-6020 (PHONE)
703-726-6024 (FAX)

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